Storm Water Management Plan
For Priority Projects
(Major SWMP)

TPM 20901
ER# 05-02-001

Project Name:	**Rosemere Lane TPM** **APN 105-841-32**
Permit Number (Land Development Projects):	**TPM 20901 RPL 1**
Work Authorization Number (CIP):	**n/a**
Applicant:	**Brian Castelli**
Applicant's Address:	**24311 Blue Ridge Road** **Lake Forrest, CA 92630**
Plan Prepare By (*Leave blank if same as applicant*):	**Aquaterra Engineering Inc.** **1843 Campesino Place** **Oceanside, CA 92054** **(760) 439-2802**
Original Date:	**December 14, 2005**
Revision Date (If applicable):	

The County of San Diego Watershed Protection, Storm Water Management, and Discharge Control Ordinance (WPO) (Ordinance No. 9424) requires all applications for a permit or approval associated with a Land Disturbance Activity must be accompanied by a Storm Water Management Plan (SWMP) (section 67.804.f). The purpose of the SWMP is to describe how the project will minimize the short and long-term impacts on receiving water quality. Projects that meet the criteria for a priority project are required to prepare a Major SWMP.

Since the SWMP is a living document, revisions may be necessary during various stages of approval by the County. Please provide the approval information requested below.

Project Review Stage	Does the SWMP need revisions?		If YES, provide Revision Date
	YES	NO	

Instructions for a Major SWMP can be downloaded at http://www.co.sandiego.ca.us/dpw/stormwater/susmp.html.

Completion of the following checklist and attachments will fulfill the requirements of a Major SWMP for the project listed above.

PROJECT DESCRIPTION

Project Location: The project is located approximately in the unincorporated area of San Diego County near the townsite of Fallbrook. The site is accessed via Rosemere Lanne. A Vicinity Map and site plan are attached for review.

Project Description: This application is for a Tentative Parcel Map for a 4 lot subdivision. The 1.586 acre site will be subdivided into 4 parcels + a remainder parcel, with a minimum lot size of 10343 s.f. net. The site will ultimately be developed for single family residences with a paved private road that will run through the center of the subdivision.

PRIORITY PROJECT DETERMINATION

Please check the box that best describes the project. Does the project meet one of the following criteria?

PRIORITY PROJECT	YES	NO
Redevelopment within the County Urban Area that creates or adds at least 5,000 net square feet of additional impervious surface area		X
Residential development of more than 10 units		X
Commercial developments with a land area for development of greater than 100,000 square feet		X
Automotive repair shops		X
Restaurants, where the land area for development is greater than 5.000 square feet		X
Hillside development, in an area with known erosive soil conditions, where there will be grading on any natural slope that is twenty-five percent or greater, if the development creates 5,000 square feet or more of impervious surface		X
Environmentally Sensitive Areas: All development and redevelopment located within or directly adjacent to or discharging directly to an environmentally sensitive area (where discharges from the development or redevelopment will enter receiving waters within the environmentally sensitive area), which either creates 2,500 square feet of impervious surface on a proposed project site or increases the area of imperviousness of a proposed project site to 10% or more of its naturally occurring condition.		X
Parking Lots 5,000 square feet or more or with 15 parking spaces or more and potentially exposed to urban runoff		X
Streets, roads, highways, and freeways which would create a new paved surface that is 5,000 square feet or greater	X	

Limited Exclusion: Trenching and resurfacing work associated with utility projects are not considered priority projects. Parking lots, buildings and other structures associated with utility projects are subject to SUSMP requirements if one or more of the criteria above are met.

If you answered **NO** to all the questions, then **STOP**. Please complete a Minor SWMP for your project. If you answered **YES** to any of the questions, please continue.

The following questions provide a guide to collecting information relevant to project stormwater quality issues. Please provide a description of the findings in text box below.

	QUESTIONS	COMPLETED	NA
1.	Describe the topography of the project area.	X	
2.	Describe the local land use within the project area and adjacent areas.	X	
3.	Evaluate the presence of dry weather flow.	X	
4.	Determine the receiving waters that may be affected by the project throughout the project life cycle (i.e., construction, maintenance and operation).	X	
5.	For the project limits, list the 303(d) impaired receiving water bodies and their constituents of concern.	X	
6.	Determine if there are any High Risk Areas (municipal or domestic water supply reservoirs or groundwater percolation facilities) within the project limits.	X	
7.	Determine the Regional Board special requirements, including TMDLs, effluent limits, etc.		X
8.	Determine the general climate of the project area. Identify annual rainfall and rainfall intensity curves.	X	
9.	If considering Treatment BMPs, determine the soil classification, permeability, erodibility, and depth to groundwater.	X	
10.	Determine contaminated or hazardous soils within the project area.	X	

Physical Features: The existing site terrain slopes in the northerly direction. "The average slope of the site is 7.35 % and there is no area over 25% slope", per the CEQA Drainage Study, prepared by ACAL Engineering.

Surrounding Land Use: The adjacent properties are developed residential.

Proposed Project Land Use: The subject application of proposed a residential subdivision will use the current zoning of RS which has a maximum density of 7.26 du/ac. No land use or zoning change is required for approval of this project.

Soil: The site is comprised of the soil type FaD2, Fallbrook Sandy Loam which is in the Hydrologic group "C", according to the San Diego County Soil Survey.

There are no dry weather flows in this area. Within the project limits, there are no 303(d) impaired water bodies, High Risk areas, known contaminated soils or special Regional Board requirements.

The general climate for this area is coastal arid with an average annual rainfall for this HSA is 13.2 inches.

Complete the checklist below to determine if Treatment Best Management Practices (BMPs) are required for the project.

No.	CRITERIA	YES	NO	INFORMATION
1.	Is this an emergency project		X	If YES, go to 6. If NO, continue to 2.
2.	Have TMDLs been established for surface waters within the project limit?		X	If YES, go to 5. If NO, continue to 3.
3.	Will the project directly discharge to a 303(d) impaired receiving water body?		X	If YES, go to 5. If NO, continue to 4.
4.	Is this project within the urban and environmentally sensitive areas as defined on the maps in Appendix B of the *County of San Diego Standard Urban Storm Water Mitigation Plan for Land Development and Public Improvement Projects*?	X		If YES, continue to 5. If NO, go to 6.
5.	Consider approved Treatment BMPs for the project.	X		If YES, go to 7.
6.	Project is not required to consider Treatment BMPs			Document for Project Files by referencing this checklist.
7.	End			

Now that the need for a treatment BMPs has been determined, other information is needed to complete the SWMP.

WATERSHED

Please check the watershed(s) for the project.

___San Juan ___Santa Margarita _X_San Luis Rey ___Carlsbad ___San Dieguito

___Penasquitos ____ San Diego ___Pueblo San Diego ___Sweetwater ___Otay ___Tijuana

Please provide the hydrologic sub-area and number(s)

Number	Name
903.12	Lower San Luis Rey - Bonsall

Please provide the beneficial uses for Inland Surface Waters and Ground Waters. Beneficial Uses can be obtained from the Water Quality Control Plan For The San Diego Basin, which is available at the Regional Board office or at http://www.swrcb.ca.gov/rwqcb9/programs/basinplan.html.

SURFACE WATERS	Hydrologic Unit Basin Number	MUN	AGR	IND	PROC	GWR	FRESH	POW	REC1	REC2	BIOL	WARM	COLD	WILD	RARE	SPWN
Inland Surface Waters	903.12	X	X	X		X	X	X	X	X		X	X	X	X	
Ground Waters	903.12	X	X	X	X		X									

X Existing Beneficial Use 0
Potential Beneficial Use
* Excepted from Municipal

POLLUTANTS OF CONCERN

Using Table 1, identify pollutants that are anticipated to be generated from the proposed priority project categories. Pollutants associated with any hazardous material sites that have been remediated or are not threatened by the proposed project are not considered a pollutant of concern.

Table 1. Anticipated and Potential Pollutants Generated by Land Use Type

	General Pollutant Categories								
Priority Project Categories	Sediments	Nutrients	Heavy Metals	Organic Compounds	Trash & Debris	Oxygen Demanding Substances	Oil & Grease	Bacteria & Viruses	Pesticides
Detached Residential Development	X	X			X	X	X	X	X
Attached Residential Development	X	X			X	P(1)	P(2)	P	X
Commercial Development >100,000 ft2	P(1)	P(1)		P(2)	X	P(5)	X	P(3)	P(5)
Automotive Repair Shops			X	X(4)(5)	X		X		
Restaurants					X	X	X	X	
Hillside Development >5,000 ft2	X	X			X	X	X		X
Parking Lots	P(1)	P(1)	X		X	P(1)	X		P(1)
Streets, Roads Highways & Freeways	X	P(1)	X	X(4)	X	P(5)	X		

X = anticipated
P = potential
(1) A potential pollutant if landscaping exists on-site.
(2) A potential pollutant if the project includes uncovered parking areas.
(3) A potential pollutant if land use involves food or animal waste products.
(4) Including petroleum hydrocarbons.
(5) Including solvents.

The above shaded rows indicate this project's General Pollutant Categories.

Note: If other monitoring data that is relevant to the project is available. Please include as Attachment C.

CONSTRUCTION BMPs

Please check the construction BMPs that may be used. The BMPs selected are those that will be implemented during construction of the project. The applicant is responsible for the placement and maintenance of the BMPs selected.

_X_ Silt Fence

__ Fiber Rolls

_X_ Street Sweeping and Vacuuming

__ Storm Drain Inlet Protection

_X_ Stockpile Management

_X_ Solid Waste Management

_X_ Stabilized Construction Entrance/Exit

__Dewatering Operations

__ Vehicle and Equipment Maintenance

_X_ Desilting Basin

_X_ Gravel Bag Berm

__ Sandbag Barrier

_X_ Material Delivery and Storage

___ Spill Prevention and Control

_X_ Concrete Waste Management

___Water Conservation Practices

_X_ Paving and Grinding Operations

__Any minor slopes created incidental to construction and not subject to a major or minor grading permit shall be protected by covering with plastic or tarp prior to a rain event, and shall have vegetative cover reestablished within 180 days of completion of the slope and prior to final building approval.

SITE DESIGN

To minimize stormwater impacts, site design measures must be addressed. The following checklist provides options for avoiding or reducing potential impacts during project planning. If YES is checked, it is assumed that the measure was used for this project. If NO is checked, please provide a brief explanation why the option was not selected in the text box below.

	OPTIONS		YES	NO	N/A
1.	Can the project be relocated or realigned to avoid/reduce impacts to receiving waters or to increase the preservation of critical (or problematic) areas such as floodplains, steep slopes, wetlands, and areas with erosive or unstable soil conditions?				X
2.	Can the project be designed to minimize impervious footprint?		X		
3.	Conserve natural areas where feasible?		X		
4.	Where landscape is proposed, can rooftops, impervious sidewalks, walkways, trails and patios be drained into adjacent landscaping?		X		
5.	For roadway projects, can structures and bridges be designed or located to reduce work in live streams and minimize construction impacts?				X
6.	Can any of the following methods be utilized to minimize erosion from slopes:				
	6.a.	Disturbing existing slopes only when necessary?	X		
	6.b.	Minimize cut and fill areas to reduce slope lengths?	X		
	6.c.	Incorporating retaining walls to reduce steepness of slopes or to shorten slopes?	X		
	6.d.	Providing benches or terraces on high cut and fill slopes to reduce concentration of flows?	X		
	6.e.	Rounding and shaping slopes to reduce concentrated flow?	X		
	6.f.	Collecting concentrated flows in stabilized drains and channels?	X		

Please provide a brief explanation for each option that was checked N/A or NO in the following box.

All of the above Site Design criteria can be adhered to except where there the criteria does not apply.

If the project includes work in channels, then complete the following checklist. Information shall be obtained from the project drainage report.

N/A. This project does not propose work in channels.

No.	CRITERIA	YES	NO	N/A	COMMENTS
1.	Will the project increase velocity or volume of downstream flow?			X	If YES go to 5.
2.	Will the project discharge to unlined channels?	X			If YES go to 5.
3.	Will the project increase potential sediment load			X	If YES go to 5.

No.	CRITERIA	YES	NO	N/A	COMMENTS
	of downstream flow?			X	
4.	Will the project encroach, cross, realign, or cause other hydraulic changes to a stream that may affect upstream and/or downstream channel stability?			X	If YES go to 7.
5.	Review channel lining materials and design for stream bank erosion.	X			Continue to 6.
6.	Consider channel erosion control measures within the project limits as well as downstream. Consider scour velocity.	X		X	Continue to 7.
7.	Include, where appropriate, energy dissipation devices at culverts.	X			Continue to 8.
8.	Ensure all transitions between culvert outlets/headwalls/wingwalls and channels are smooth to reduce turbulence and scour.			X	Continue to 9.
9.	Include, if appropriate, detention facilities to reduce peak discharges.			X	
10.	"Hardening" natural downstream areas to prevent erosion is not an acceptable technique for protecting channel slopes, unless pre-development conditions are determined to be so erosive that hardening would be required even in the absence of the proposed development.			X	Continue to 11.
11.	Provide other design principles that are comparable and equally effective.			X	Continue to 12.
12.	End				

SOURCE CONTROL

Please complete the following checklist for Source Control BMPs. If the BMP is not applicable for this project, then check N/A only at the main category.

BMP			YES	NO	N/A
1.	**Provide Storm Drain System Stenciling and Signage**				
	1.a.	All storm drain inlets and catch basins within the project area shall have a stencil or tile placed with prohibitive language (such as: "NO DUMPING – DRAINS TO _____") and/or graphical icons to discourage illegal dumping.	X		
	1.b.	Signs and prohibitive language and/or graphical icons, which prohibit illegal dumping, must be posted at public access points along channels and creeks within the project area.	X		
2.	**Design Outdoors Material Storage Areas to Reduce Pollution Introduction**				
	2.a.	This is a detached single-family residential project. Therefore, personal storage areas are exempt from this requirement.	X		

BMP			YES	NO	N/A
	2.b.	Hazardous materials with the potential to contaminate urban runoff shall either be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with runoff or spillage to the storm water conveyance system; or (2) protected by secondary containment structures such as berms, dikes, or curbs.			X
	2.c.	The storage area shall be paved and sufficiently impervious to contain leaks and spills.			X
	2.d.	The storage area shall have a roof or awning to minimize direct precipitation within the secondary containment area.			X
3.	**Design Trash Storage Areas to Reduce Pollution Introduction**				
	3.a.	Paved with an impervious surface, designed not to allow run-on from adjoining areas, screened or walled to prevent off-site transport of trash; or,	X		
	3.b.	Provide attached lids on all trash containers that exclude rain, or roof or awning to minimize direct precipitation.	X		
4.	**Use Efficient Irrigation Systems & Landscape Design**		X		
	The following methods to reduce excessive irrigation runoff shall be considered, and incorporated and implemented where determined applicable and feasible.		X		
	4.a.	Employing rain shutoff devices to prevent irrigation after precipitation.	X		
	4.b.	Designing irrigation systems to each landscape area's specific water requirements.	X		
	4.c.	Using flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.	X		
	4.d.	Employing other comparable, equally effective, methods to reduce irrigation water runoff.	X		
5.	**Private Roads**		X		
	The design of private roadway drainage shall use at least one of the following				
	5.a.	Rural swale system: street sheet flows to vegetated swale or gravel shoulder, curbs at street corners, culverts under driveways and street crossings.	X		
	5.b.	Urban curb/swale system: street slopes to curb, periodic swale inlets drain to vegetated swale/biofilter.	X		
	5.c.	Dual drainage system: First flush captured in street catch basins and discharged to adjacent vegetated swale or gravel shoulder, high flows connect directly to storm water conveyance system.			X
	5.d.	Other methods that are comparable and equally effective within the project.	X		
6.	**Residential Driveways & Guest Parking**				X
	The design of driveways and private residential parking areas shall use one at least of the following features.				
	6.a.	Design driveways with shared access, flared (single lane at street) or wheelstrips (paving only under tires); or, drain into landscaping prior to discharging to the storm water conveyance system.			

	6.b.	Uncovered temporary or guest parking on private residential lots may be: paved with a permeable surface; or, designed to drain into landscaping prior to discharging to the storm water conveyance system.			
	6.c.	Other features which are comparable and equally effective.			
7.	**Dock Areas**				X

	BMP		YES	NO	N/A
	Loading/unloading dock areas shall include the following.				
	7.a.	Cover loading dock areas, or design drainage to preclude urban run-on and runoff.			
	7.b.	Direct connections to storm drains from depressed loading docks (truck wells) are prohibited.			
	7.c.	Other features which are comparable and equally effective.			
8.	**Maintenance Bays**				X
	Maintenance bays shall include the following.				
	8.a.	Repair/maintenance bays shall be indoors; or, designed to preclude urban run-on and runoff.			
	8.b.	Design a repair/maintenance bay drainage system to capture all wash water, leaks and spills. Connect drains to a sump for collection and disposal. Direct connection of the repair/maintenance bays to the storm drain system is prohibited. If required by local jurisdiction, obtain an Industrial Waste Discharge Permit.			
	8.c.	Other features which are comparable and equally effective.			
9.	**Vehicle Wash Areas**				X
	Priority projects that include areas for washing/steam cleaning of vehicles shall use the following.				
	9.a.	Self-contained; or covered with a roof or overhang.			
	9.b.	Equipped with a clarifier or other pretreatment facility.			
	9.c.	Properly connected to a sanitary sewer.			
	9.d.	Other features which are comparable and equally effective.			
10.	**Outdoor Processing Areas**				X
	Outdoor process equipment operations, such as rock grinding or crushing, painting or coating, grinding or sanding, degreasing or parts cleaning, waste piles, and wastewater and solid waste treatment and disposal, and other operations determined to be a potential threat to water quality by the County shall adhere to the following requirements.				
	10.a.	Cover or enclose areas that would be the most significant source of pollutants; or, slope the area toward a dead-end sump; or, discharge to the sanitary sewer system following appropriate treatment in accordance with conditions established by the applicable sewer agency.			
	10.b.	Grade or berm area to prevent run-on from surrounding areas.			
	10.c.	Installation of storm drains in areas of equipment repair is prohibited.			
	10.d.	Other features which are comparable or equally effective.			
11.	**Equipment Wash Areas**				X
	Outdoor equipment/accessory washing and steam cleaning activities shall be.				
	11.a.	Be self-contained; or covered with a roof or overhang.			
	11.b.	Be equipped with a clarifier, grease trap or other pretreatment facility, as appropriate			
	11.c.	Be properly connected to a sanitary sewer.			

	11.d.	Other features which are comparable or equally effective.			
12.	**Parking Areas**				X
	The following design concepts shall be considered, and incorporated and implemented where determined applicable and feasible by the County.				
	12.a.	Where landscaping is proposed in parking areas, incorporate landscape areas into the drainage design.			

	BMP		YES	NO	N/A
	12.b.	Overflow parking (parking stalls provided in excess of the County's minimum parking requirements) may be constructed with permeable paving.			
	12.c.	Other design concepts that are comparable and equally effective.			
13.	**Fueling Area**				
	Non-retail fuel dispensing areas shall contain the following.				X
	13.a.	Overhanging roof structure or canopy. The cover's minimum dimensions must be equal to or greater than the area within the grade break. The cover must not drain onto the fuel dispensing area and the downspouts must be routed to prevent drainage across the fueling area. The fueling area shall drain to the project's treatment control BMP(s) prior to discharging to the storm water conveyance system.			
	13.b.	Paved with Portland cement concrete (or equivalent smooth impervious surface). The use of asphalt concrete shall be prohibited.			
	13.c.	Have an appropriate slope to prevent ponding, and must be separated from the rest of the site by a grade break that prevents run-on of urban runoff.			
	13.d.	At a minimum, the concrete fuel dispensing area must extend 6.5 feet (2.0 meters) from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot (0.3 meter), whichever is less.			

Please list other project specific Source Control BMPs in the following box. Write **N/A** if there are none and briefly explain.

N/A All applicable Source Control BMPs can be adhered to for this project.

TREATMENT CONTROL

To select a structural treatment BMP using Treatment Control BMP Selection Matrix (Table 2), each priority project shall compare the list of pollutants for which the downstream receiving waters are impaired (if any), with the pollutants anticipated to be generated by the project (as identified in Table 1). Any pollutants identified by Table 1, which are also causing a Clean Water Act section 303(d) impairment of the receiving waters of the project, shall be considered primary pollutants of concern. Priority projects that are anticipated to generate a primary pollutant of concern shall select a single or combination of stormwater BMPs from Table 2, which **maximizes pollutant removal** for the particular primary pollutant(s) of concern.

Priority projects that are **not** anticipated to generate a pollutant for which the receiving water is Clean Water Act Section 303(d) impaired shall select a single or combination of stormwater BMPs from Table 2, which are effective for pollutant removal of the identified secondary pollutants of concern, consistent with the "maximum extent practicable" standard.

Table 2. Treatment Control BMP Selection Matrix

Pollutant of Concern	*Treatment Control BMP Categories*						
	Biofilters	Detention Basins	Infiltration Basins(2)	Wet Ponds or Wetlands	Drainage Inserts	Filtration	Hydrodynamic Separator Systems(3)
Sediment	M	H	H	H	L	H	M
Nutrients	L	M	M	M	L	M	L
Heavy Metals	M	M	M	H	L	H	L
Organic Compounds	U	U	U	M	L	M	L
Trash & Debris	L	H	U	H	M	H	M
Oxygen Demanding Substances	L	M	M	M	L	M	L
Bacteria	U	U	H	H	L	M	L
Oil & Grease	M	M	U	U	L	H	L
Pesticides	U	U	U	L	L	U	L

(1) Copermittees are encouraged to periodically assess the performance characteristics of many of these BMPs to update this table.
(2) Including trenches and porous pavement.
(3) Also known as hydrodynamic devices and baffle boxes.
L: Low removal efficiency: M: Medium removal efficiency: H: High removal efficiency: U: Unknown removal efficiency
Sources: *Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters* (1993), *National Stormwater Best Management Practices Database* (2001), *Guide for BMP Selection in Urban Developed Areas* (2001), *and Caltrans New Technology Report (2001).*

A Treatment BMP must address runoff from developed areas. Please provide the post-construction water quality values for the project. Label outfalls on the BMP map. Q_{WQ} is dependent on the type of treatment BMP selected for the project.

Outfall	**Tributary Area (acres)**	**Q_{100} (cfs)**	**Q_{WQ} (cfs)**
Parcels 1-4 + remain.	1.586	4.36	2.04

Please check the box(s) that best describes the Treatment BMP(s) selected for this project.

Biofilters

_X_ Grass swale
__ Grass strip
__ Wetland vegetation swale
_X_ Bioretention (Rain Garden)

Detention Basins

__ Extended/dry detention basin with grass lining
__ Extended/dry detention basin with impervious lining

Infiltration Basins

__Infiltration basin
__Infiltration trench
__Porous asphalt
__Porous concrete
__Porous modular concrete block

Wet Ponds or Wetlands

__Wet pond/basin (permanent pool)
__Constructed wetland

Drainage Inserts (See note below)

__Oil/Water separator
__Catch basin insert
__Storm Drain inserts
__Catch basin screens

Filtration

__Media filtration
__Sand filtration

Hydrodynamic Separator Systems

__Swirl Concentrator
__Cyclone Separator
__Baffle Separator
__Gross Solids Removal Device
__Linear Radial Device

Note: Catch basin inserts and storm drain inserts are excluded from use on County maintained right-of-way and easements.

Include Treatment Datasheet as Attachment E. The datasheet should include the following:	**COMPLETED**	**NO**
1. Description of how treatment BMP was designed. Provide a description for each type of treatment BMP.	X	
2. Engineering calculations for the BMP(s)	X	

Please describe why the selected treatment BMP(s) was selected for this project. For projects utilizing a low performing BMP, please provide a detailed explanation and justification.

The Treatment BMPs selected for this project is a Biofilter (Vegetated Swale TC-30) and a small on-site Bioretention Basin (Rain Garden) . This Biofilter was selected for its efficiency (medium) at removing the main pollutants of concern, Sediments, heavy metals and Oil & Grease for the runoff water generated by this project. The biofilter is also easy to maintain and therefore will

ensure the efficiency of the project long term. The Rain Garden was also selected for its easy maintenance and its aesthetic appeal.

Another Treatment BMPs that was considered was Catch Basin Inserts were considered however were not as cost-effective and were harder to maintain than the Biofilter and Retention Basin, and were therefore not chosen.

MAINTENANCE

Please check the box that best describes the maintenance mechanism(s) for this project. 13

CATEGORY	SELECTED	
	YES	NO
First	X	
Second		X
Third		X
Fourth		X

Please briefly describe the long-term fiscal resources for the selected maintenance mechanism(s).

The owner of the project will be responsible for maintaining the Treatment BMP.

ATTACHMENTS

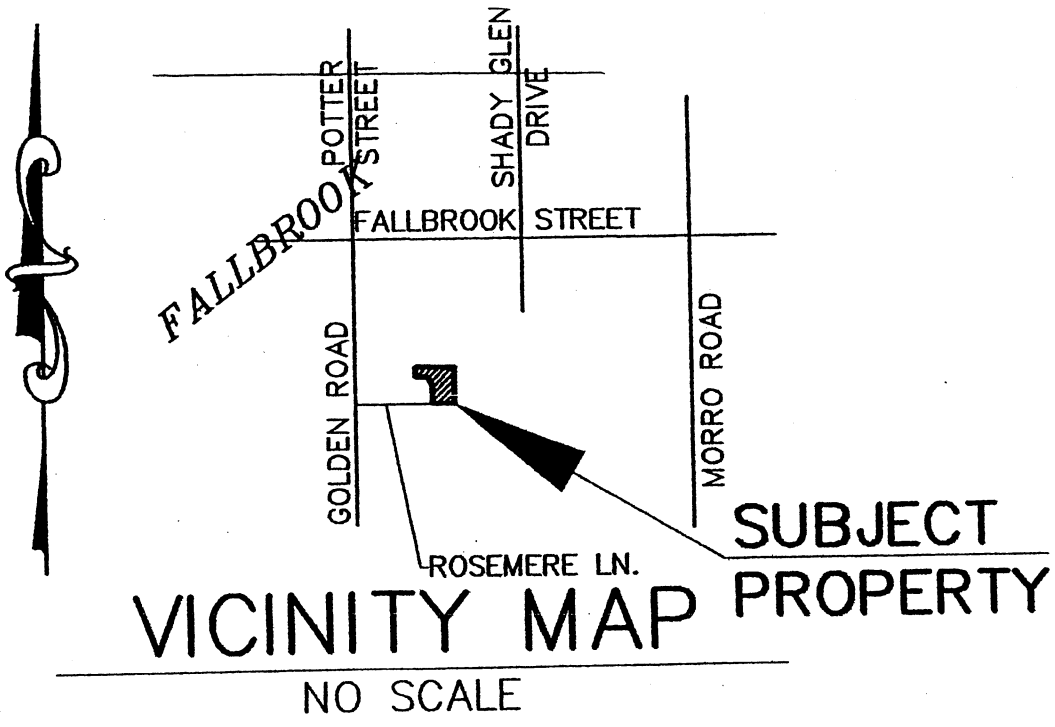
Please include the following attachments.

	ATTACHMENT	COMPLETED	N/A
A	Project Location Map	X	
B	Site Map	X	
C	Relevant Monitoring Data	X	
D	Treatment BMP Location Map	X	
E	Treatment BMP Datasheets	X	
F	Operation and Maintenance Program for Treatment BMPs	X	
G	Engineer's Certification Sheet	X	

Note: Attachments A and B are combined.

ATTACHMENT A & B

LOCATION MAP &
PROJECT SITE MAP



ATTACHMENT C

RELEVANT MONITORING DATA

(NOTE: PROVIDE RELEVANT WATER QUALITY MONITORING DATA IF AVAILABLE.)

No relevant Monitoring date is available

ATTACHMENT D

TREATMENT BMP LOCATION MAP

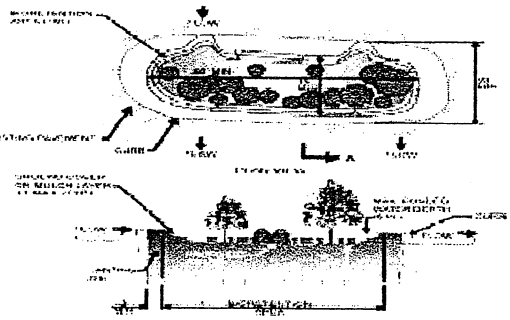
ATTACHMENT E

TREATMENT BMP DATASHEET

(NOTE: POSSIBLE SOURCE FOR DATASHEETS CAN BE FOUND AT WWW.CABMPHANDBOOKS.COM. INCLUDE ENGINEERING CALCULATIONS FOR SIZING THE TREATMENT BMP.)

ACTIVITY: Bioretention Basins (Rain Gardens)

F – 05



Targeted Constituents				
☞☞ Significant Benefit		☞ Partial Benefit		☞☞Low or Unknown Benefit
☞ Sediment	☞ Heavy Metals	☞☞Floatable Materials		☞ Oxygen Demanding Substances
☞ Nutrients	☞ Toxic Materials	☞ Oil & Grease	☞☞Bacteria & Viruses	☞☞Construction Wastes

Implementation Requirements			
☞☞ High	☞ Medium		☞☞Low
☞ Capital Costs	☞ O & M Costs	☞ Maintenance	☞☞Training

Description

The bioretention basin, or "rain garden", was developed by the Prince George's County, Maryland Department of Environmental Protection. It consists of seven components: The grass buffer strip; the ponding area; the surface mulch and planting soil; the sand bed; the organic layer; the plant material; and the infiltration chambers. Bioretention basins are planting areas installed in shallow basins, where stormwater runoff is filtered through the various layers mentioned above. Biological and chemical reactions occur around the roots of the plants, and water infiltrates into the soil below. Bioretention basins enhance stormwater quality through adsorption, filtration, volitization, ion exchange, microbial soil processes, evapotranspiration, nutrient uptake in plants, and decomposition prior to exfiltration into the surrounding soil mass. Such basins also enhance infiltration and groundwater recharge, thus reducing the volume of stormwater runoff.

Selection Criteria

The primary use of this BMP is for water quality control, although they provide some protection against flooding and streambank erosion, depending on the size of the basin. Bioretention basins are suitable for use at any site where the subsoil provides reasonable infiltration, and the water table is sufficiently lower than the design depth of the basin. These basins are usually designed for drainage areas of less than one acre.

Areas that have mature trees that would need to be removed, have slopes greater than 20%, and are above or close to an unstable soil strata are not appropriate areas for rain gardens. In addition, this BMP will not function properly in sites subjected to continuous or frequent flows, as the sand filter will not have time to dry and aerate.

Design and Sizing Considerations

Rain gardens are often located in the following areas:

- Landscaping islands
- Small drainage areas
- Highly impervious areas, such as parking lots

Properly designed rain gardens replicate a dense forest floor, through the use of certain plants, mulches, and nutrient-rich soils. Since rain gardens often have aesthetic value, it is recommended that the designer has working knowledge and design skills of

indigenous horticultural practices, such as a landscape architect.

The size of the facility is based on the amount of impervious surface in the drainage area. For example, for facilities treating the first 0.5 inches of runoff from the impervious areas in the catchment, the surface area of the rain garden is typically small, but should be a minimum of 2.5% of the impervious area. For facilities treating the first 1 inch, the surface area should be a minimum of 5% of the impervious area.

Bioretention areas will typically need to be used in conjunction with another structural control to provide channel protection as well as overbank flood protection. It is important to ensure that a bioretention area safely bypasses higher flows.

Other design elements are as follows:

- The minimum width and length of the rain garden is 10 feet by 15 feet.
- Maximum contributing drainage area is 5 acres. 0.5 to 2 acres are preferred. Multiple rain gardens can be used for larger drainage areas.
- The site slope should be no more than 6%.
- feet distance is recommended between the bioretention facility and the seasonally high water table.
- Rain gardens typically require 5 feet of head.
- The rain garden should be designed to completely drain within 48 hours. They should not be used on sites with a continuous flow from groundwater, sump pumps, or other sources.
- Bioretention area locations should be integrated into the site planning process, and aesthetic considerations should be taken into account in their siting and design. Elevations must be carefully worked out to ensure that the desired runoff flow enters the facility with no more than the maximum design depth.
- The maximum recommended ponding depth of the bioretention areas is 6 inches.

Grass Buffer Strip

The grass buffer strip pretreats the runoff. It filters particles from the stormwater runoff by reducing the velocity. Often, the buffer strip is enhanced with a pea gravel ribbon, to spread the runoff and increase infiltration through the strip. The minimum filter strip length should be 10 feet.

Sand Bed

The sand bed further slows the runoff, and spreads the runoff over the entire basin. As the water infiltrates into the sand, the water is filtered. Drainage must be designed to flow away from the sand bed, in order to guard against anaerobic conditions in the planting area, and provide exfiltration from the basin. The sand bed should be 12 to 18 inches thick. Sand should be clean and have less than 15% silt or clay content.

Ponding Area

The ponding area detains runoff waiting to be treated. It also allows for pre-settling of particulates in the stormwater runoff. The ponding area should be constructed in accordance with Section P-01, Detention Basin. The pond should be equipped with an overflow structure, with its invert elevation 0.5 feet above the organic layer.

Organic Layer

The organic, or mulch, layer filters the pollutants in the runoff, protects the soil from eroding, and provides an environment for microbes to degrade pollutants, such as petroleum-based solvents. The mulch layer may consist of either fine shredded hardwood mulch or shredded hardwood chips, and should be applied uniformly at a depth of 2-3 inches. Grass clippings are not suitable, since they contain excessive quantities of nitrogen that would limit the capability of the rain garden to filter nitrogen in stormwater runoff.

Planting Soil Layer

This layer stores water and nutrients for the plants. Clay particles in the layer adsorb heavy metals, hydrocarbons, and other pollutants. The planting soil bed must be at least 4 feet in depth. Planting soils should be sandy loam, loamy sand, or loam texture.

Plant Material

The plant species should be selected with great care, depending on their ability to treat pollutants through their interaction with other plants, soil, and the organic layer. Other factors to consider when choosing vegetation include climate of the site, shape, growth rates, maintenance requirements, size, hardiness, and type of root system. A variety of plants should be selected, in order to combat insects and disease, and increase envirotranspiration and aesthetic beauty.

Infiltration Chambers

Vented infiltration chambers provide exfiltration through open-bottomed cavities, decrease ponding time above the basin, and aerate the filter media between storms through the cavities and vents to the surface. By providing a valve equipped drawdown drain to daylight, the basin can be converted into a soil media filter should exfiltration surface failures occur.

Underdrain Collection System

The underdrain collection system is equipped with a 6-inch perforated PVC pipe (AASHTO M 252) in an 8-inch gravel layer. The pipe should have 3/8-inch perforations, spaced at 6-inch centers, with a minimum of 4 holes per row. The pipe is spaced at a maximum of 10 feet on center and a minimum grade of 0.5% must be maintained. A permeable filter fabric is placed between the gravel layer and the planting soil bed.

Construction/ Inspection Considerations

Sediment must be controlled during and after construction of the rain garden. Since infiltration is a key component of the rain garden, rain gardens are not recommended as the site of sediment detention basins during construction, as sediments tend to clog underlying soil strata. The bioretention basin will function more efficiently if the entire system is fully stabilized with vegetative and structural practices.

Use relatively light, tracked equipment during construction, to avoid compaction of the basin floor.

Maintenance

The structure and vegetation of the rain garden should be inspected and maintained frequently to assure proper function.

- Pests and weeds should be extracted from the facility.
- The facility should be frequently removed of debris and sediment.
- This BMP requires extensive landscaping.
- Rain gardens are not recommended for areas with steep slopes.

Cost Considerations

This BMP costs more than other filtering systems.

Limitations

A great deal of knowledge of engineering and horticultural knowledge is required for the successful implementation of this BMP. Maintenance and frequent inspections are also necessary.

Additional Information

Examples and applications of several different types of bioretention basins are illustrated on the following pages. The reader is referred to the Tennessee Erosion & Sediment Control Handbook for further discussion on vegetative practices (TDEC, 2002).

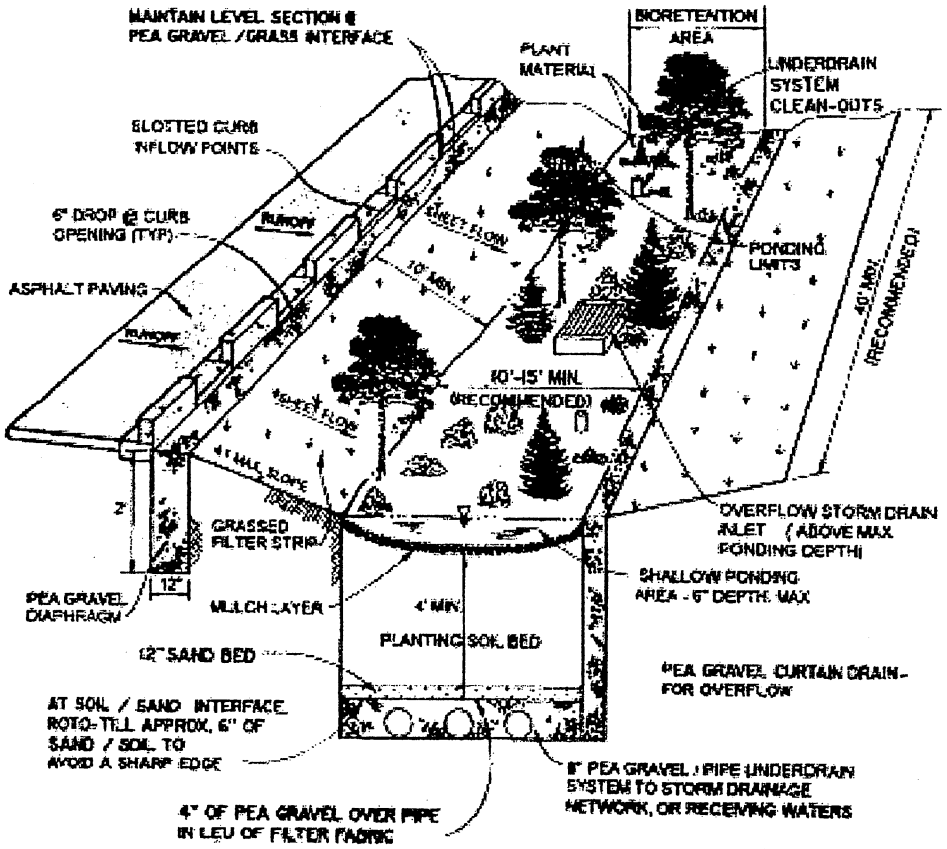


Figure F-05-1 – Bioretention Basin
(Prince George's County, MD, 1993)

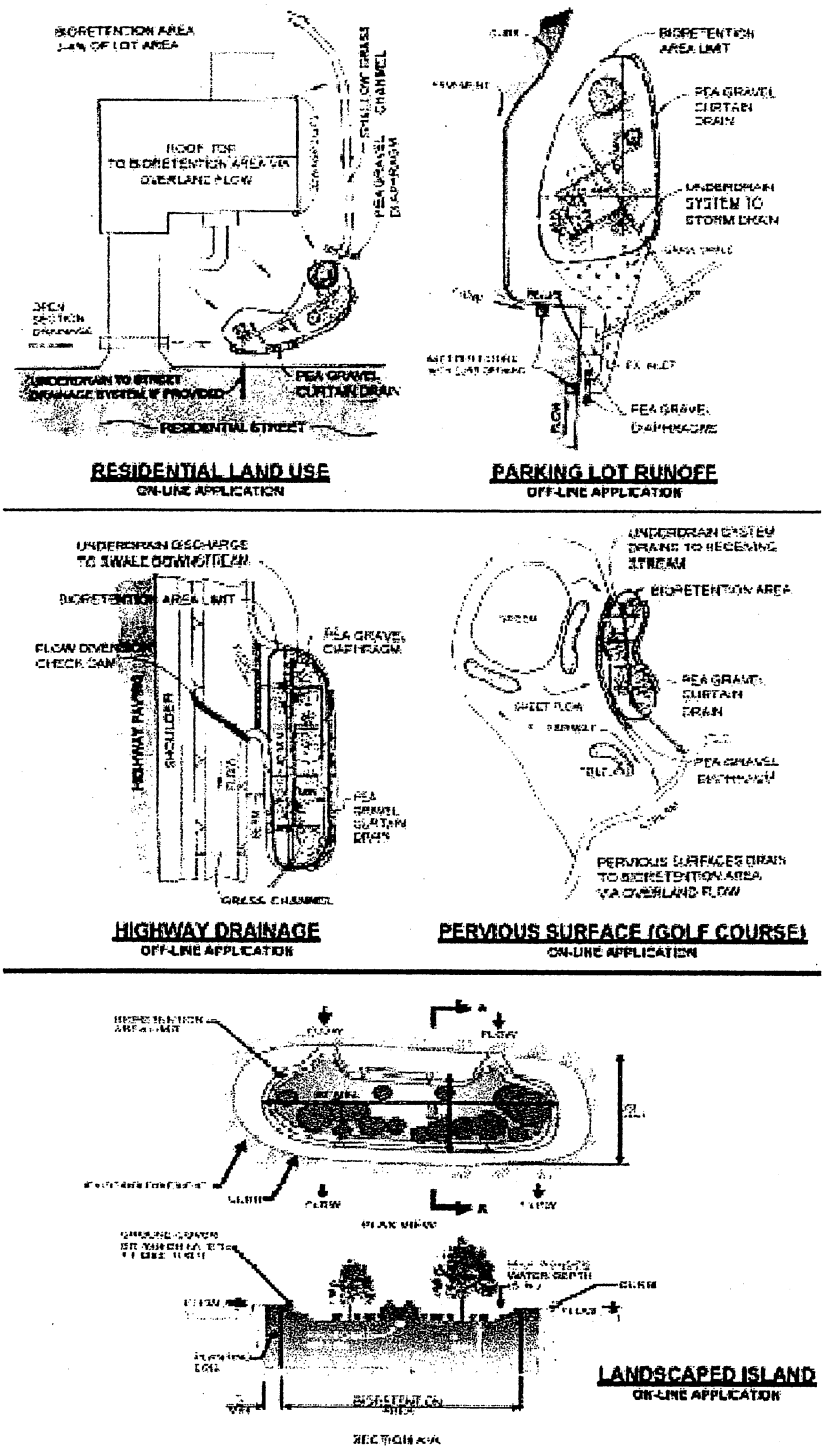


Figure F-05-2 – Bioretention Area Applications (ARC, 2001)

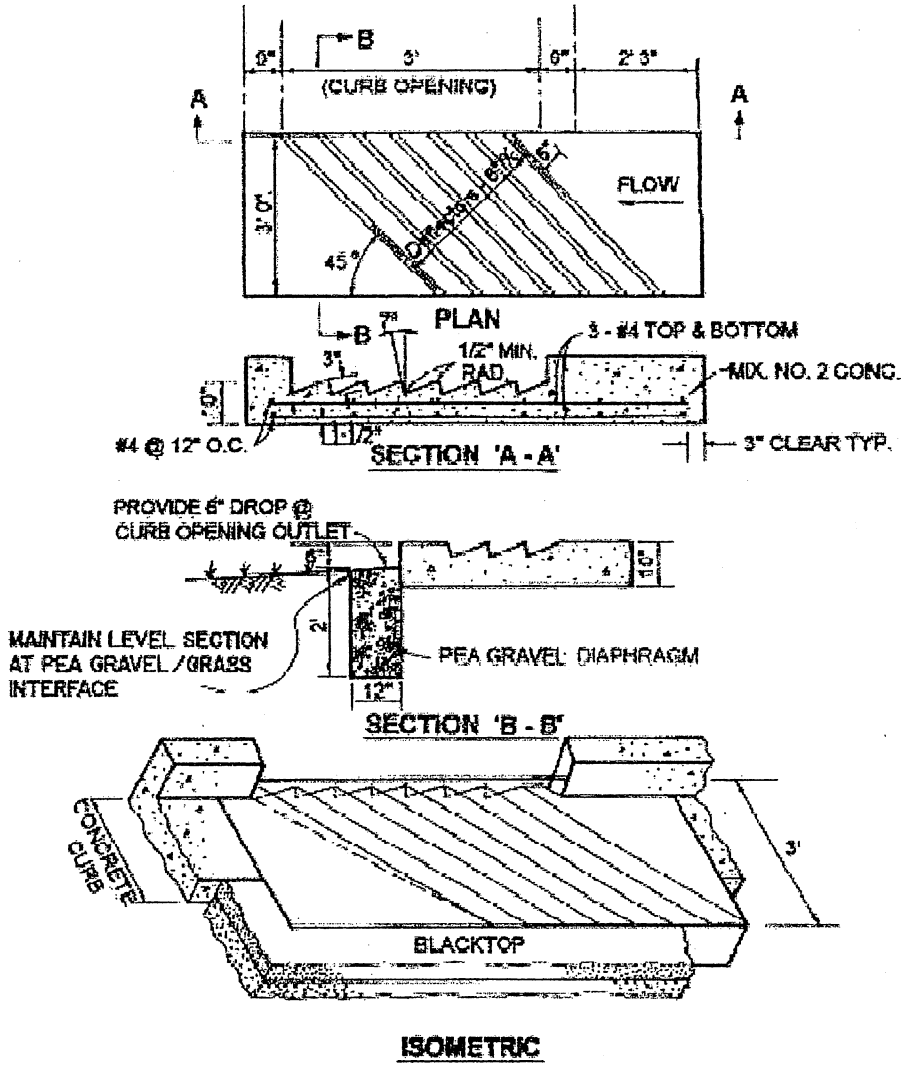


Figure F-05-3 – Typical Inlet Deflector
(Prince George's County, MD, 1993)

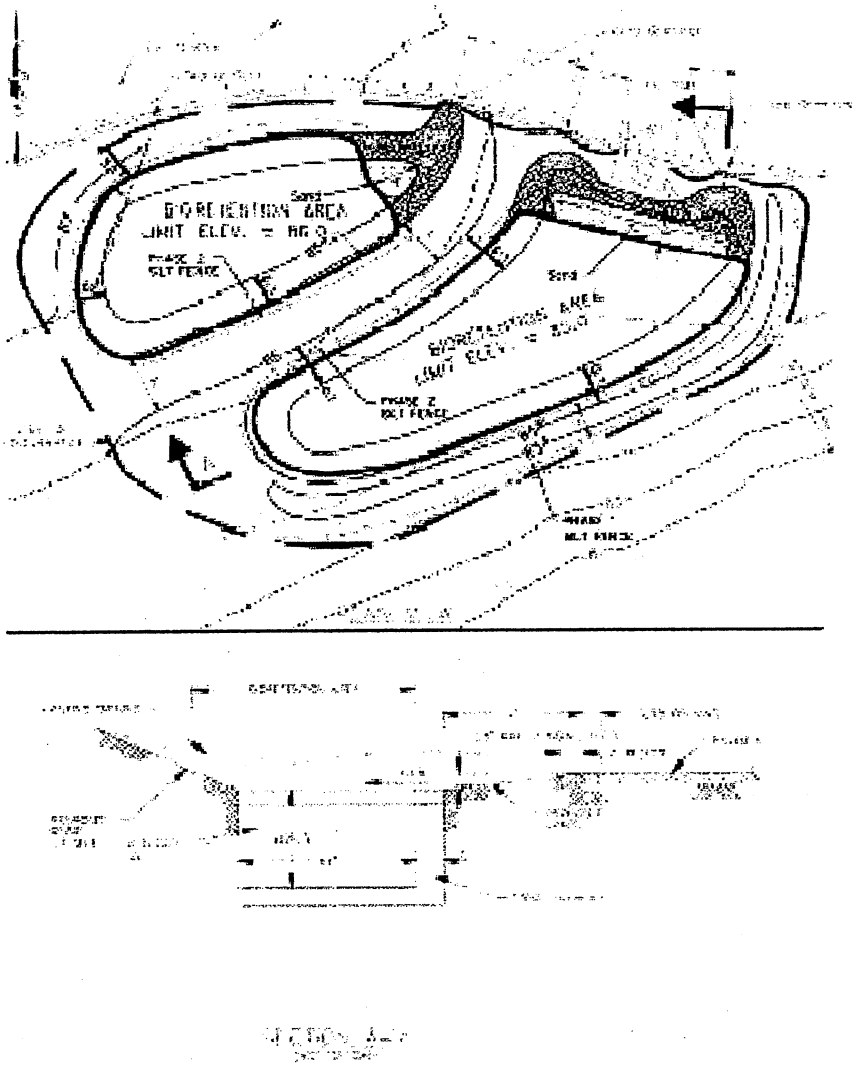


Figure F-05-4 – Grading Plan for Bioretention Basin (Virginia, 1999)

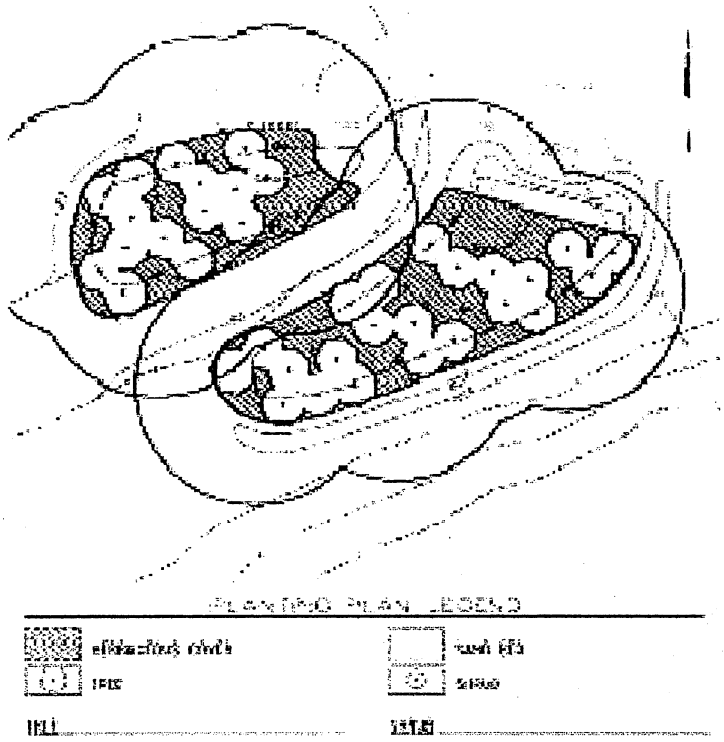


Figure F-05-5 – Sample Planting Plan for Bioretention Basin (Virginia, 1999)

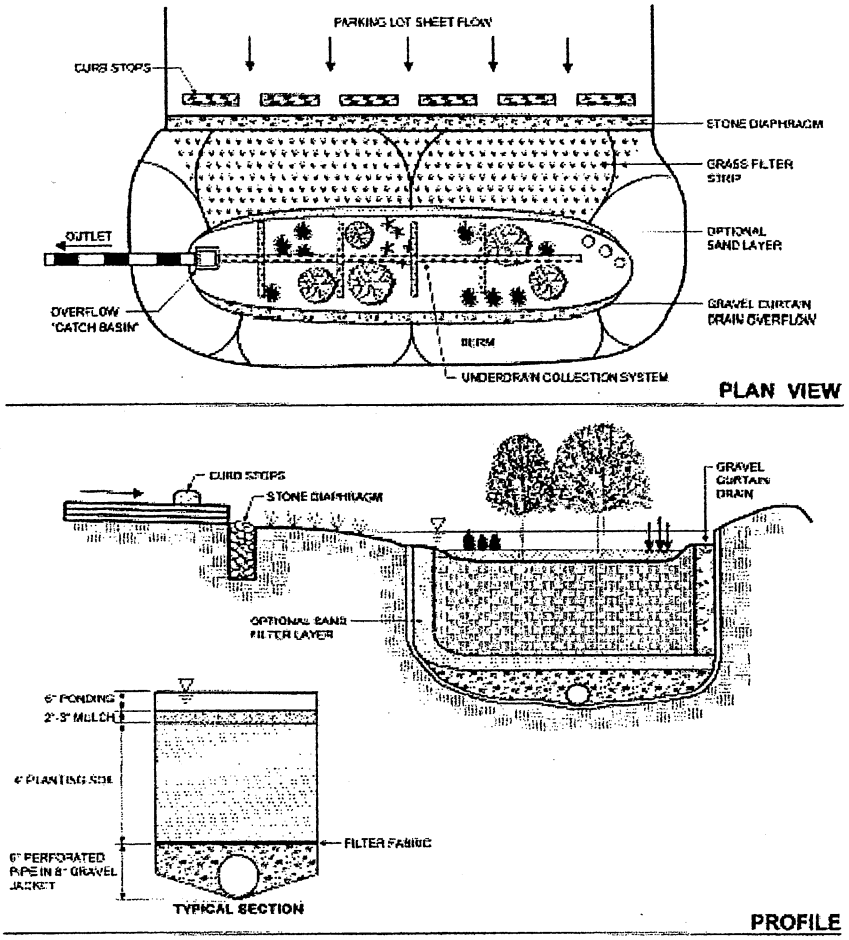


Figure F-05-6 – Typical On-line Bioretention Area (ARC, 2001)

References

Atlanta Regional Commission. *Georgia Stormwater Management Manual.* First edition, 2001.

Prince Georges County, Maryland. *Design Manual of Use of Bioretention in Stormwater Management*, Prince Georges County, 1993.

Tennessee Department of Environment and Conservation (TDEC), *Tennessee Erosion & Sediment Control Handbook – A Guide for Protection of State Waters through the use of Best Management Practices during Land Disturbing Activities*, March 2002.

Virginia Department of Conservation and Recreation, Division of Soil and Water Conservation. *Virginia Stormwater Management Handbook*, First Edition, 1999.

Step by Step Guide to

Building Your Own Rain Garden

You may have heard about rain gardens lately. They have received a lot of attention in the news for their ability to improve water quality in Minnesota's rivers and lakes. Rain gardens are areas where storm water is captured and allowed to infiltrate into the ground. They are also known by other names: bioretention basins, ephemeral wetlands, water quality gardens, storm water gardens, planted swales, biofilters, or strategically placed puddles.

For rain gardens near roads, select plants that can tolerate de-icing salts.

Rain Garden Basics

Typically a rain garden is formed by a shallow depression – 4 to 8 inches deep for a residential yard and less than 32 inches deep for large-scale treatment – with permeable soils that drain quickly (in less than 72 hours). The rain garden is typically planted with water-absorbing native plants that can withstand intermittent flooding. The rain garden should be strategically located to collect, filter and infiltrate rain that falls on hard surfaces like roofs, driveways, alleys or streets.

Rain gardens serve to minimize the negative impact excessive runoff from these surfaces has on lakes and streams. Some rain gardens have drain pipes and impervious liners, but most do not.

Why Should We Care About Rain Gardens?

Minnesota is the Land of 10,000 Lakes and the home of the Mississippi headwaters. Minnesota also borders the largest freshwater body in the world – Lake Superior. The lakes, streams and rivers are an integral part of Minnesota's development. All of our water is interconnected. Rainfall either infiltrates the ground and becomes ground water or runs off and becomes storm water. Both groundwater and stormwater reach rivers and lakes. Breaking up the expanses of pavement that capture water with green space can greatly improve water quality.

Where can I see rain gardens?

- Victory Drive, in front of BandanaBrewery, Mankato
- Lion's Lake, Mankato (coming soon)
- City of Maplewood — residential streetside gardens
- 806 Rushmore Drive, Burnsville — residential
- MN Landscape Arboretum, Chanhassan
- Swede Hollow Café, St. Paul
- Como Park — Lexington Pkwy & Nebraska Ave., St. Paul
- Mount Calvary Lutheran Church, Excelsior
- Marcy-Holmes neighborhood, Minneapolis
- 706 14th Ave SE (condos), Minneapolis
- 1205 7th Ave SE (single family home), Minneapolis
- North corner of 4th St SE and 8th Ave SE (Andrew-Riverside Park), Minneapolis
- Downtown Wayzata
- Kwanzaa Community Church, 2100 Emerson Ave. N, Minneapolis
- El Colegio Charter School, 4137 Bloomington Ave. S, Minneapolis

Benefits of a Rain Garden

- Soaks up 30% more runoff than lawns
- Keeps runoff on site
- Filters polluted urban runoff (oil, grease, salts, fertilizers, pesticide residue)
- Recharges groundwater
- Helps prevent flooding
- Provides habitat and food for butterflies and birds
- Beautifies a low spot, and
- Serves as a natural filter, removing sediment, phosphorus and nitrogen from runoff.

Where can rain gardens be integrated into our communities?

- New residential developments
- New commercial/industrial/ institutional developments
- Roadway projects
- Redevelopment
- Revitalization and smart growth projects
- Urban retrofit storm water management projects
- Streetscaping projects
- Private residential landscaping
- Parks and trailways
- Commercial/industrial/public landscapes
- Curbless and curbed parking lot perimeters
- Parking lot islands/medians
- Adjacent swales

Flexibility in Design

Rain garden design features are flexible. Variables include: location, soil type, size and shape, and plants.

Select plants that tolerate both wet and dry spells.

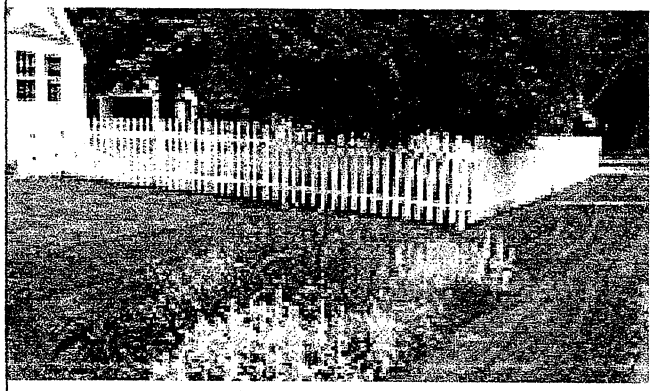
When picking a location for your rain garden you will want to "go with the flow." First, observe the drainage pattern in the landscape via topographic maps or site visit. Then locate the garden in a natural low spot: near sidewalks, driveways or other impervious surfaces; or down-slope from roofs, gutters, downspouts and sump pump outlets. Avoid septic system drainfields. Use a channel or buried plastic pipe to direct water into the rain garden.

Most importantly, the soil must drain! Make sure you place your rain garden in the right soils by doing a percolation test on the rain garden site. Fill a 6-inch deep hole with water, and it should drain within 24 hours. If not, don't put the rain garden in that spot.
If it does drain, fill the hole again and time the rate of infiltration in inches per hour. The soil should drain at one inch per hour minimum. The higher the infiltration rate, the smaller the garden needs to be.

There is no standard size or shape. Kidney or teardrop shapes seem to work well. The rule of thumb is that your rain garden area should be five to ten percent of the drainage area you are directing toward it. For example, a 50 to 100 square foot. rain garden accommodates 1,000 square feet of impervious area. Factors for optimal size include slope, soil type and distance from the runoff point. The longer side of the garden should face upslope in order to catch as much runoff as possible and to spread the water flow over a larger area. Even a small rain garden is beneficial.

Once you have decided on the right place for your garden, you can get outside and get dirty. Outline the boundary with a rope or hose to help you visualize the garden. Call Gopher State One Call (1-800-252-1166) at least two working days before digging to make sure you don't cut any utility lines. Remove the sod and dig to your desired depth. Mix in compost to improve the soil's infiltration capacity.

The garden should be level in the deepest spot. Gentle side slopes help prevent erosion and are safer if someone steps into the garden. A berm at the low end — less than 18 inches — helps hold the water in the garden. A grass filter strip on the top edge helps slow down the water before it enters the garden and settle out some of the sediment in the runoff. Mulch helps prevent weeds, aids in removing nitrogen from the water and makes the garden look nice. Use shredded wood mulch rather than chips, which can float away when the garden fills up with water.



Locate your rain garden in a natural low spot — near sidewalks, driveways or other impervious surfaces, or down-slope from roofs, gutters, downspouts and sump pump outlets.

What plants should you choose?

Select plants that tolerate both wet and dry spells, tolerate de-icing salts (if near roads) and match up with existing soil and light conditions. Put plants that tolerate saturated soils in the deepest part. Grasses can help support flowers, and their roots help crowd out weeds. Generally, you will need one plant per square foot of rain garden, with a third of the plants for the wet zone, and two-thirds for the upland zone.

Native plants have many advantages: they are adapted to the climate and native pests, deep rooted, tolerate dry spells, have long roots to draw water deep from the soil and evapotranspire, and they are havens for butterflies, birds and beneficial insects. However, traditional ornamental garden plants may be more appropriate in a refined cultural setting.

Regardless of whether you pick native species or ornamentals, make sure the plants can handle getting their feet wet occasionally. If your rain garden will be exposed to road de-icing salts, pick plants that can handle those conditions.

Some salt-tolerant native species are columbine, purple coneflower, black-eyed Susan, showy goldenrod, rough blazing star and big bluestem grass.

Some salt-tolerant ornamental species are hosta, coral bells, Stella D'Oro day lily, Silver Mound artemisia, Autumn Joy sedum, Blue Lyme grass and fountain grass.

Maintenance

Rain gardens can be high or low maintenance, based on the plants you choose. After installation, pull weeds (especially important the first year) and water three times per week for the first two weeks and during dry spells. Fertilizer is not necessary or desirable, because it encourages weeds and strains soil filtering capacity. Over the long term, replace mulch (shredded hardwood, which aids denitrification) as necessary. Thin and transplant plants as needed. Leave seed heads on over the winter for wildlife habitat and winter interest, then burn, cut back or mow them down in the spring. For large-scale gardens, you may consider hiring a maintenance contractor for first two to five years. Adding "elements of care" such as ornamental fences, birdbaths, gazing balls and other accessories helps show observers that this is a special garden

What about mosquitos?

Rain gardens, when designed correctly, will not provide a breeding ground for mosquitoes, for the following reasons:

- A rain garden is not a pond
- There is no standing water between rainfalls (the garden should drain in less than 72 hours)
- Mosquitoes need at least seven

days in standing water one to twelve inches deep in order to hatch. They will not survive if the rain garden dries in less than one week. Therefore, there is no West Nile Virus threat from rain gardens.

How much will it cost?

If you do it yourself, it will generally cost $3 to $5 per square foot, including plants. If you hire professionals, it will generally cost $10 to $12 per square foot.

For your money, you get a two-fold return: the satisfaction of doing your part to protect Minnesota's water resources, and an attractive addition to your property.

Bolton & Menk's Chantill Kahler-Royer, the author of this article, gave presentations on rain gardens to the Bolton & Menk offices as a brown bag lunch meeting last December and at the 2nd Annual Environmental Sustainability Conference at Minnesota State University, Mankato in February. For more information on rain gardens, contact Chantill at chantillka@bolton-menk.com.

References

Rain Garden Basics

- City of Maplewood
  www.ci.maplewood.mn.us
  Click on "Welcome to Maplewood Storm Water Management," then click on "Rainwater Gardens"
- Friends of Bassett Creek
  www.mninter.net/~stack/rain
- UW Extension
  http://clean-water.uwex.edu/pubs/raingarden/
- Rain Gardens of West Michigan
  www.raingardens.org

More In-depth Information

- Met Council's "Minnesota Urban Small Sites BMP Manual"
  www.metrocouncil.org/environment/watershed/bmp/manual.htm
- Prince George's County, MD's Dept. of Environmental Resources Bioretention Manual
  www.goprincegeorgescounty.com/government/agencyindex/der/ppd/lid/bioretention.asp
- Low Impact Development Center
  www.lid-stormwater.net/bioretention/biolowres_specs.htm

Vegetated Swale TC-30

Design Considerations

- Tributary Area
- Area Required
- Slope
- Water Availability

Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems.

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	●
☑	Metals	▲
☑	Bacteria	●
☑	Oil and Grease	▲
☑	Organics	▲

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

California Experience

Caltrans constructed and monitored six vegetated swales in southern California. These swales were generally effective in reducing the volume and mass of pollutants in runoff. Even in the areas where the annual rainfall was only about 10 inches/yr, the vegetation did not require additional irrigation. One factor that strongly affected performance was the presence of large numbers of gophers at most of the sites. The gophers created earthen mounds, destroyed vegetation, and generally reduced the effectiveness of the controls for TSS reduction.

Advantages

- If properly designed, vegetated, and operated, swales can serve as an aesthetic, potentially inexpensive urban development or roadway drainage conveyance measure with significant collateral water quality benefits.

- Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible.

Limitations

- Can be difficult to avoid channelization.
- May not be appropriate for industrial sites or locations where spills may occur
- Grassed swales cannot treat a very large drainage area. Large areas may be divided and treated using multiple swales.
- A thick vegetative cover is needed for these practices to function properly.
- They are impractical in areas with steep topography.
- They are not effective and may even erode when flow velocities are high, if the grass cover is not properly maintained.
- In some places, their use is restricted by law: many local municipalities require curb and gutter systems in residential areas.
- Swales are mores susceptible to failure if not properly maintained than other treatment BMPs.

Design and Sizing Guidelines

- Flow rate based design determined by local requirements or sized so that 85% of the annual runoff volume is discharged at less than the design rainfall intensity.
- Swale should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, which ever is less, at the design treatment rate.
- Longitudinal slopes should not exceed 2.5%
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equation using a value of 0.25 for Manning's n.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.
- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.
- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.
- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.
- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.

Performance

The literature suggests that vegetated swales represent a practical and potentially effective technique for controlling urban runoff quality. While limited quantitative performance data exists for vegetated swales, it is known that check dams, slight slopes, permeable soils, dense grass cover, increased contact time, and small storm events all contribute to successful pollutant removal by the swale system. Factors decreasing the effectiveness of swales include compacted soils, short runoff contact time, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities and discharge rates.

Conventional vegetated swale designs have achieved mixed results in removing particulate pollutants. A study performed by the Nationwide Urban Runoff Program (NURP) monitored three grass swales in the Washington, D.C., area and found no significant improvement in urban runoff quality for the pollutants analyzed. However, the weak performance of these swales was attributed to the high flow velocities in the swales, soil compaction, steep slopes, and short grass height.

Another project in Durham, NC, monitored the performance of a carefully designed artificial swale that received runoff from a commercial parking lot. The project tracked 11 storms and concluded that particulate concentrations of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. However, the swale proved largely ineffective for removing soluble nutrients.

The effectiveness of vegetated swales can be enhanced by adding check dams at approximately 17 meter (50 foot) increments along their length (See Figure 1). These dams maximize the retention time within the swale, decrease flow velocities, and promote particulate settling. Finally, the incorporation of vegetated filter strips parallel to the top of the channel banks can help to treat sheet flows entering the swale.

Only 9 studies have been conducted on all grassed channels designed for water quality (Table 1). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorus.

Table 1 Grassed swale pollutant removal efficiency data							
	Removal Efficiencies (% Removal)						
Study	TSS	TP	TN	NO_3	Metals	Bacteria	Type
Caltrans 2002	77	8	67	66	83-90	-33	dry swales
Goldberg 1993	67.8	4.5	-	31.4	42–62	-100	grassed channel
Seattle Metro and Washington Department of Ecology 1992	60	45	-	-25	2–16	-25	grassed channel
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	-25	46–73	-25	grassed channel
Wang et al., 1981	80	-	-	-	70–80	-	dry swale
Dorman et al., 1989	98	18	-	45	37–81	-	dry swale
Harper, 1988	87	83	84	80	88–90	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988.	81	17	40	52	37–69	-	wet swale
Koon, 1995	67	39	-	9	-35 to 6	-	wet swale

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although some swales appear to export soluble phosphorus (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils.

Siting Criteria

The suitability of a swale at a site will depend on land use, size of the area serviced, soil type, slope, imperviousness of the contributing watershed, and dimensions and slope of the swale system (Schueler et al., 1992). In general, swales can be used to serve areas of less than 10 acres, with slopes no greater than 5 %. Use of natural topographic lows is encouraged and natural drainage courses should be regarded as significant local resources to be kept in use (Young et al., 1996).

Selection Criteria (NCTCOG, 1993)

- Comparable performance to wet basins
- Limited to treating a few acres
- Availability of water during dry periods to maintain vegetation
- Sufficient available land area

Research in the Austin area indicates that vegetated controls are effective at removing pollutants even when dormant. Therefore, irrigation is not required to maintain growth during dry periods, but may be necessary only to prevent the vegetation from dying.

The topography of the site should permit the design of a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls. Recommendations for longitudinal slopes range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.

Additional Design Guidelines

Most of the design guidelines adopted for swale design specify a minimum hydraulic residence time of 9 minutes. This criterion is based on the results of a single study conducted in Seattle, Washington (Seattle Metro and Washington Department of Ecology, 1992), and is not well supported. Analysis of the data collected in that study indicates that pollutant removal at a residence time of 5 minutes was not significantly different, although there is more variability in that data. Therefore, additional research in the design criteria for swales is needed. Substantial pollutant removal has also been observed for vegetated controls designed solely for conveyance (Barrett et al, 1998); consequently, some flexibility in the design is warranted.

Many design guidelines recommend that grass be frequently mowed to maintain dense coverage near the ground surface. Recent research (Colwell et al., 2000) has shown mowing frequency or grass height has little or no effect on pollutant removal.

Summary of Design Recommendations

1) The swale should have a length that provides a minimum hydraulic residence time of at least 10 minutes. The maximum bottom width should not exceed 10 feet unless a dividing berm is provided. The depth of flow should not exceed 2/3rds the height of the grass at the peak of the water quality design storm intensity. The channel slope should not exceed 2.5%.

2) A design grass height of 6 inches is recommended.

3) Regardless of the recommended detention time, the swale should be not less than 100 feet in length.

4) The width of the swale should be determined using Manning's Equation, at the peak of the design storm, using a Manning's n of 0.25.

5) The swale can be sized as both a treatment facility for the design storm and as a conveyance system to pass the peak hydraulic flows of the 100-year storm if it is located "on-line." The side slopes should be no steeper than 3:1 (H:V).

6) Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible. If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.

7) Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation

establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials.

Maintenance

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.
- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.
- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.
- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.
- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Cost

Construction Cost

Little data is available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately $0.25 per ft². This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most stormwater management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately $0.50 per ft², which compares favorably with other stormwater management practices.

Table 2 Swale Cost Estimate (SEWRPC, 1991)

Component	Unit	Extent	Unit Cost			Total Cost		
			Low	Moderate	High	Low	Moderate	High
Mobilization / Demobilization-Light	Swale	1	$107	$274	$441	$107	$274	$441
Site Preparation								
Clearing[b]	Acre	0.5	$2,200	$3,800	$5,400	$1,100	$1,900	$2,700
Grubbing[c]	Acre	0.25	$3,800	$5,200	$6,600	$950	$1,300	$1,650
General Excavation[d]	Yd³	372	$2.10	$3.70	$5.30	$781	$1,376	$1,972
Level and Till[e]	Yd²	1,210	$0.20	$0.35	$0.50	$242	$424	$605
Sites Development								
Salvaged Topsoil Seed, and Mulch[f]	Yd²	1,210	$0.40	$1.00	$1.60	$484	$1,210	$1,936
Sod[g]	Yd²	1,210	$1.20	$2.40	$3.60	$1,452	$2,904	$4,356
Subtotal	–	–	--	–	–	$5,116	$9,388	$13,660
Contingencies	Swale	1	25%	25%	25%	$1,279	$2,347	$3,415
Total	–	–	--	–	–	$6,395	$11,735	$17,075

Source: (SEWRPC, 1991)

Note: Mobilization/demobilization refers to the organization and planning involved in establishing a vegetative swale.

[a] Swale has a bottom width of 1.0 foot, a top width of 10 feet with 1:3 side slopes, and a 1,000-foot length.

[b] Area cleared = (top wicth + 10 feet) x swale length.

[c] Area grubbed = (top width x swale length).

[d] Volume excavated = (0.67 x top width x swale depth) x swale length (parabolic cross-section).

[e] Area tilled = $\left(\text{top width} + \frac{8(\text{swale depth}^2)}{3(\text{top width})}\right)$ x swale length (parabolic cross-section).

[f] Area seeded = area cleared x 0.5.

[g] Area sodded = area cleared x 0.5.

Table 3 Estimated Maintenance Costs (SEWRPC, 1991)

Component	Unit Cost	Swale Size (Depth and Top Width)		Comment
		1.5 Foot Depth, One-Foot Bottom Width, 10-Foot Top Width	3-Foot Depth, 3-Foot Bottom Width, 21-Foot Top Width	
Lawn Mowing	$0.85 / 1,000 ft²/ mowing	$0.14 / linear foot	$0.21 / linear foot	Lawn maintenance area=(top width + 10 feet) x length. Mow eight times per year
General Lawn Care	$9.00 / 1,000 ft²/ year	$0.18 / linear foot	$0.28 / linear foot	Lawn maintenance area = (top width + 10 feet) x length
Swale Debris and Litter Removal	$0.10 / linear foot / year	$0.10 / linear foot	$0.10 / linear foot	--
Grass Reseeding with Mulch and Fertilizer	$0.30 / yd²	$0.01 / linear foot	$0.01 / linear foot	Area revegetated equals 1% of lawn maintenance area per year
Program Administration and Swale Inspection	$0.15 / linear foot / year, plus $25 / inspection	$0.15 / linear foot	$0.15 / linear foot	Inspect four times per year
Total	--	$0.56 / linear foot	$ 0.75 / linear foot	--

Maintenance Cost

Caltrans (2002) estimated the expected annual maintenance cost for a swale with a tributary area of approximately 2 ha at approximately $2,700. Since almost all maintenance consists of mowing, the cost is fundamentally a function of the mowing frequency. Unit costs developed by SEWRPC are shown in Table 3. In many cases vegetated channels would be used to convey runoff and would require periodic mowing as well, so there may be little additional cost for the water quality component. Since essentially all the activities are related to vegetation management, no special training is required for maintenance personnel.

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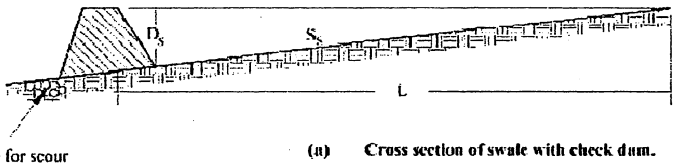
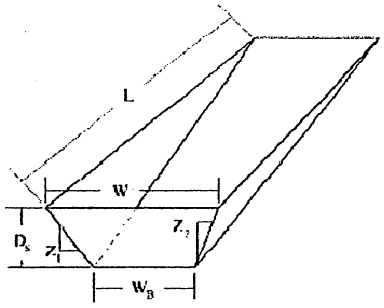


Provide for scour protection.

(a) Cross section of swale with check dam.



(b) Dimensional view of swale impoundment area.

Notation:

L = Length of swale impoundment area per check dam (ft)
D_s = Depth of check dam (ft)
S_s = Bottom slpe of swale (ft/ft)
W = Top width of check dam (ft)
W_B = Bottom width of check dam (ft)
$Z_{1&2}$ = Ratio of horizontal to vertical change in swale side slope (ft/ft)

WATER QUALITY CALCULATIONS

Flow and Volume based Treatment Control BMPs will be designed to mitigate (infiltrate, filter or treat) the volume of runoff produced from a 24-hour 85th percentile storm event, as determined form the local historical rainfall record and shown on the official County Isopluvial Map for the 85th percentile storm. Numeric Sizing for the Treatment control BMPs follows:

Roof Surface

Flow based calculation:

$Q = C\ I\ A$ Q = allowable Q
I = 0.2 in/hr
A = Impervious Surface = 5000 s.f. = 0.15 ac.
C = coefficient of runoff = 1.0

$Q = C\ I\ A = 1.0\ (0.2)\ (0.15) = 0.030$ cfs

The allowable Q for the on-site swales @ 2% is 8.0 cfs.

(T1) Infiltrative Vegetative Swales (BIOSWALES)- Runoff from each lot will be directed to a Infiltrative Vegetative Swale, before discharging to the Rain Gardens. This landscaped swale will be designed to provide infiltration of the storm water before it leaves the property as well as storage of the differential volume between the pre & post runoff. See "Attachment E" for design criteria and Site Plan for locations.

Infiltrative Vegetated Swales are vegetated channels that receive directed flow and convey storm water. Pollutants are removed through the grass, sedimentation, adsorption to soil particles, and infiltration through soil. Swales and strips are mainly effective at removing debris and solid particles, although some dissolved constituents are removed by adsorption onto the soil.

Efficiency: Likely to have a significant impact on Sediment, debris and Non-visible pollutants, such as fertilizer.

Likely to have a significant impact on Sediment and Non-visible pollutants.

Street & Driveways

V= A a C P

V = required storage volume of Basin
A = area of proposed impervious surface (streets)
5000 s.f.

a = 1

P = Precipitation = 0. 65" = 0.054'

V = 5000 X 1 X .054 = 270 CF

(T2) Rain Garden (Retention Basin) – The mitigated runoff will be stored in a Rain Garden or individual Retention Basin at the edge of each parcel and will be released at specified Pre-development flows.

Rain Gardens are basins who outlets have been designed to detain the stormwater runoff in order to mitigate increased runoff generated by development. Due to the simplicity of design, Rain Gardens are easy and inexpensive to maintain and construct.

The proposed Bioretention area is estimated to be sufficient for this volume. Hydrologic Calculations will be provided at the Final Engineering phase of this project. Site Plan (attached).

allowable for swale

Q =	
slope	0.02
n	0.025
area	2
perimete	6
r = a/p	0.3333
Q =	8.0795

ATTACHMENT F

OPERATION AND MAINTENANCE PROGRAM FOR TREATMENT BMP

(NOTE: INFORMATION REGARDING OPERATION AND MAINTENANCE CAN BE OBTAINED FROM THE FOLLOWING WEB SITE:

HTTP://WWW.SDCOUNTY.CA.GOV/DPW/WATERSHEDS/LAND_DEV/SUSMP.HTML.)

Operation & Maintenance Plan

Biofilter (Grass-lined Swale)

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

1) Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.

2) Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.

3) Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.

4) Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.

5) Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Adopted from the California Stormwater BMP Handbook, New Development and Redevelopement, www.cabmphandbooks.com, January 2003.

OPERATION AND MAINTENANCE OF THE RAIN GARDEN IS INCLUDED IN THE BMP SPECIFICATION SHEETS.

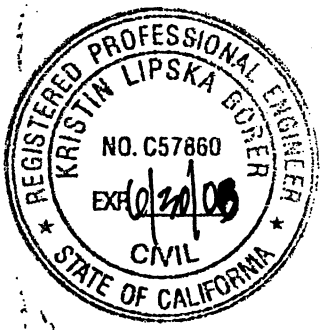
ATTACHMENT G

CERTIFICATION SHEET

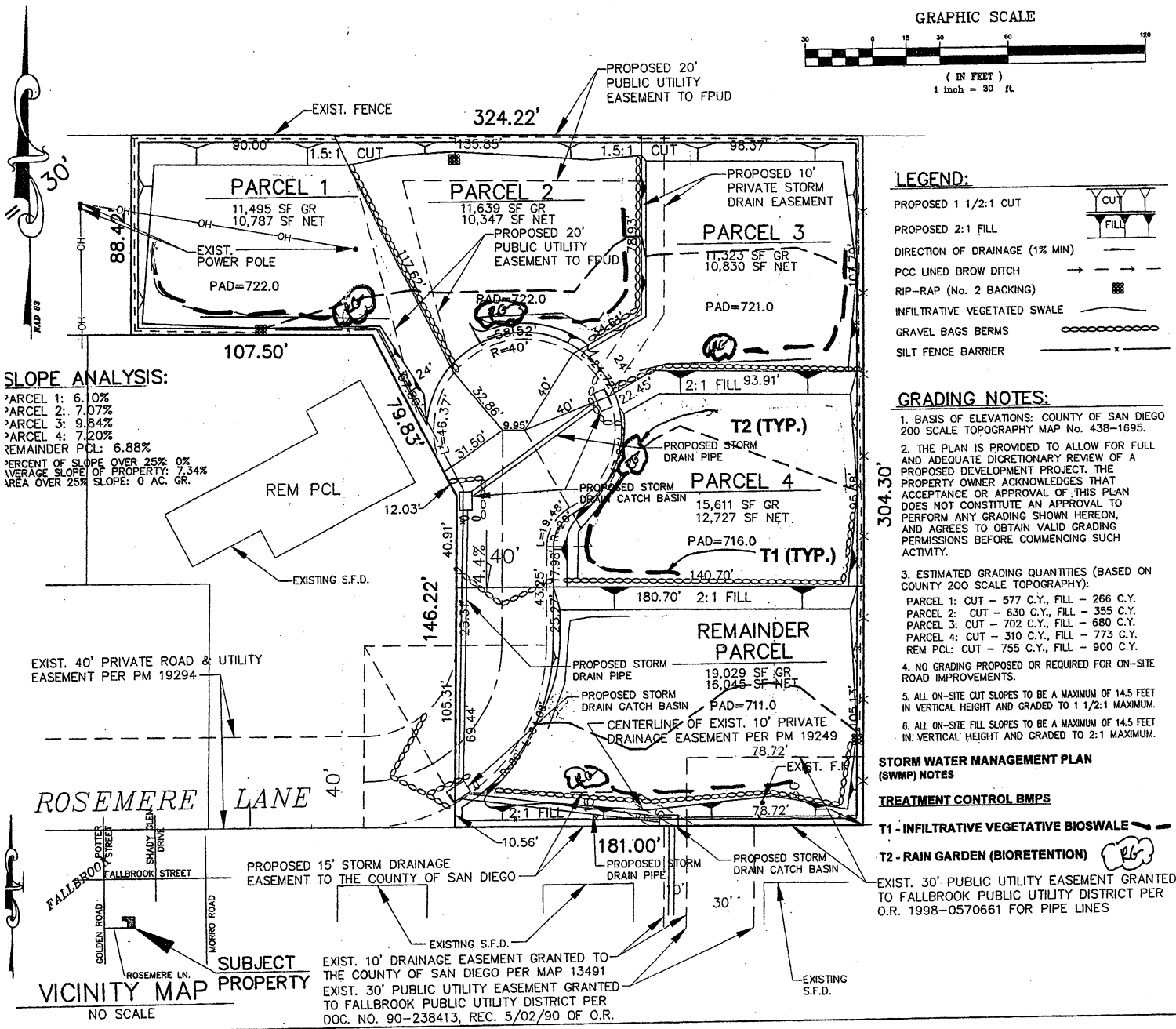
This Stormwater Management Plan has been prepared under the direction of the following Registered Civil Engineer. The Registered Civil Engineer attests to the technical information contained herein and the engineering data upon which recommendations, conclusions, and decisions are based.

Kristin Lipska Borer
C 57860 Exp. 6/30/06

12/14/05
Date



PRELIMINARY GRADING PLAN FOR TPM 20901



SLOPE ANALYSIS:

PARCEL 1: 6.10%
PARCEL 2: 7.07%
PARCEL 3: 9.84%
PARCEL 4: 7.20%
REMAINDER PCL: 6.88%
PERCENT OF SLOPE OVER 25%: 0%
AVERAGE SLOPE OF PROPERTY: 7.34%
AREA OVER 25% SLOPE: 0 AC. GR.

LEGEND:

- PROPOSED 1 1/2:1 CUT
- PROPOSED 2:1 FILL
- DIRECTION OF DRAINAGE (1% MIN)
- PCC LINED BROW DITCH
- RIP-RAP (No. 2 BACKING)
- INFILTRATIVE VEGETATED SWALE
- GRAVEL BAGS BERMS
- SILT FENCE BARRIER

GRADING NOTES:

1. BASIS OF ELEVATIONS: COUNTY OF SAN DIEGO 200 SCALE TOPOGRAPHY MAP No. 438-1695.
2. THE PLAN IS PROVIDED TO ALLOW FOR FULL AND ADEQUATE DICRETIONARY REVIEW OF A PROPOSED DEVELOPMENT PROJECT. THE PROPERTY OWNER ACKNOWLEDGES THAT ACCEPTANCE OR APPROVAL OF THIS PLAN DOES NOT CONSTITUTE AN APPROVAL TO PERFORM ANY GRADING SHOWN HEREON, AND AGREES TO OBTAIN VALID GRADING PERMISSIONS BEFORE COMMENCING SUCH ACTIVITY.
3. ESTIMATED GRADING QUANTITIES (BASED ON COUNTY 200 SCALE TOPOGRAPHY):
   - PARCEL 1: CUT - 577 C.Y., FILL - 266 C.Y.
   - PARCEL 2: CUT - 630 C.Y., FILL - 355 C.Y.
   - PARCEL 3: CUT - 702 C.Y., FILL - 680 C.Y.
   - PARCEL 4: CUT - 310 C.Y., FILL - 773 C.Y.
   - REM PCL: CUT - 755 C.Y., FILL - 900 C.Y.
4. NO GRADING PROPOSED OR REQUIRED FOR ON-SITE ROAD IMPROVEMENTS.
5. ALL ON-SITE CUT SLOPES TO BE A MAXIMUM OF 14.5 FEET IN VERTICAL HEIGHT AND GRADED TO 1 1/2:1 MAXIMUM.
6. ALL ON-SITE FILL SLOPES TO BE A MAXIMUM OF 14.5 FEET IN VERTICAL HEIGHT AND GRADED TO 2:1 MAXIMUM.

STORM WATER MANAGEMENT PLAN (SWMP) NOTES

TREATMENT CONTROL BMPS

T1 - INFILTRATIVE VEGETATIVE BIOSWALE

T2 - RAIN GARDEN (BIORETENTION)

LAND DIVISION STATEMENT
OWNER'S CERTIFICATE

I HEREBY CERTIFY THAT I AM THE RECORD OWNER, AS SHOWN ON THE LATEST EQUILIZED COUNTY ASSESSMENT, OF THE PROPERTY SHOWN ON THE PARCEL MAP. ALL OF MY CONTIGUOUS OWNERSHIP WITHIN AND BEYOND THE BOUNDARIES OF THE TENTATIVE PARCEL MAP IS SHOWN. THE BASIS OF CREATION OF THE LOTS IN MY OWNERSHIP (e.g. PARCEL MAP, FINAL MAP, CERTIFICATE OF COMPLIANCE, RECORDED BEFORE 2/1/72) IS INDICATED ON THE TENTATIVE PARCEL MAP. I UNDERSTAND THAT PROPERTY IS CONSIDERED CONTIGUOUS EVEN IF IT IS SEPARATED BY ROADS, STREETS, UTILITY EASEMENTS OR RAILROAD RIGHTS-OF-WAY. "FREEWAY" AS DEFINED IN SECTION 23.5 OF THE STREETS AND HIGHWAYS CODE, SHALL NOT BE CONSIDERED AS ROADS OR STREETS.

I FURTHER CERTIFY THAT I WILL NOT, BY THIS APPLICATION, CREATE OR CAN CAUSE TO BE CREATED, OR WILL HAVE PARTICIPATED IN THE CREATION OF MORE THAN FOUR PARCELS ON CONTIGUOUS PROPERTY UNLESS SUCH PARCELS WERE CREATED BY A MAJOR SUBDIVISION. FOR PURPOSES OF THIS CERTIFICATION, THE TERM "PARTICIPATION" MEANS HAVING COOPERATED WITH OR ACTING IN A PLANNING, COORDINATING OR DECISION-MAKING CAPACITY IN ANY FORMAL OR INFORMAL ASSOCIATION OR PARTNERSHIP FOR THE PURPOSE OF DIVIDING REAL PROPERTY.

I CERTIFY UNDER PENALTY OF PERJURY THE FOREGOING IS TRUE AND CORRECT.

EXECUTED THIS 16th DAY OF AUGUST 2004, AT FALLBROOK, CALIFORNIA;

BRIAN CASTELLI
24311 BLUE RIDGE ROAD
LAKE FORREST, CA 92630
949-598-9180

1A. THE COMPLETE TAX ASSESSOR'S PARCEL NUMBER IS: 105-841-32
1B. THE TAX RATE AREA IS: 75164
2. ABBREVIATED LEGAL DESCRIPTION OF THE LAND SHOWN ON THIS PARCEL MAP IS: PARCEL 4 OF PM 19294
3. GENERAL PLAN: C.T.
4. REGIONAL CATEGORY: C.R.D.A.
5. COMMUNITY PLAN: FALLBROOK
6. EXISTING ZONING:

SETBACKS:
FRONT - 50' TO ℄
REAR - 25' TO P
SIDE - 10' TO P
EXTERIOR SIDE - 35' TO ℄

SPECIAL AREA REG USE REGULATIONS		RS4
NEIGHBORHOOD REGULATIONS		Q
	DENSITY	4.35
	LOT SIZE	10,000
	BUILDING TYPE	C
	MAXIMUM FLOOR AREA	----
	FLOOR AREA RATIO	----
	HEIGHT	G
	COVERAGE	----
	SETBACK	H
	OPEN SPACES	----
SPECIAL AREA REGULATIONS		----

7. ASSOCIATED PERMITS: NONE
8. LOCATION AND STATUS OF EXISTING LEGAL ACCESS TO SUBJECT PROPERTY FROM A PUBLICALY MAINTAINED ROAD (i.e. RECORDED EASEMENT, UNRECORDED EASEMENT - IDENTIFY AND SPECIFY WIDTH):
   ROSEMERE LANE, 40 FEET IN WIDTH
9. WATER SOURCE/WATER DISTRICT: FALLBROOK PUBLIC UTILITY DISTRICT
10. SEPTIC/SEWER DISTRICT: FALLBROOK PUBLIC UTILITY DISTRICT
11. FIRE DISTRICT: NORTH COUNTY FIRE PROTECTION DISTRICT
12. SCHOOL DISTRICTS: FALLBROOK UNION HIGH SCHOOL DIST. (GRADES 6-12)
    FALLBROOK UNION ELEM. SCHOOL DIST. (GRADES K-5)
13. TOPO INDEX: 438-1695
14. THIS PLAN IS PROVIDED TO ALLOW FOR FULL AND ADEQUATE DISCRETIONARY REVIEW OF A PROPOSED DEVELOPMENT PROJECT. THE PROPERTY OWNER ACKNOWLEDGES THAT ACCEPTANCE OR APPROVAL OF THIS PLAN DOES NOT CONSTITUTE AN APPROVAL TO PERFORM ANY GRADING SHOWN HEREON, AND AGREES TO OBTAIN A VALID GRADING PERMIT BEFORE COMMENCING SUCH ACTIVITY. GRADING SHOWN HEREON FOR DESIGN PURPOSES ONLY. NO GRADING PROPOSED AS APART OF THIS APPLICATION.
15. SOLAR ACCESS: ALL LOTS WITHIN THIS SUBDIVISION HAVE A MINIMUM OF 100 SQUARE FEET OF SOLAR ACCESS FOR EACH FUTURE DWELLING ALLOWED BY THIS SUBDIVISION.

SIGNATURE OF APPLICANT (IF NOT OWNER)
ACAL ENGINEERING & SURVEYING
990 VALE TERRACE DRIVE
VISTA, CA 92084
(760) 724-7674

DAVID H. LOWEN, RCE 31915
ACAL ENGINEERING & SURVEYING
990 VALE TERRACE DRIVE
VISTA, CA 92084
(760) 724-7674

TPM 20901

ACAL ENGINEERING & SURVEYING
JOB NO. 04-757

PRELIMINARY GRADING PLAN
TREATMENT BMP LOCATION MAP